भारतीय मानक

( Reaffirmed 1998 )

# तप्त बेल्लित कार्बन इस्पात की चद्दरें एवं पत्तियाँ — विशिष्टि

( पाँचवां पुनरीक्षण )

*Indian Standard*

# HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

*( Fifth Revision )*

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BUREAU OF INDIAN STANDARDS
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Price Group 3

## FOREWORD

This Indian Standard ( Fifth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1958 and subsequently revised in 1962, 1968, 1973 and 1988. While reviewing this standard in the light of experience gained during these years, the Committee decided to revise it to align with the present practices being followed by the Indian Industry.

In this revision, the following changes have been made:

i) Only Grades O, D, DD and EDD of hot rolled carbon steel sheets and strips have been retained. The other three grades, that is Grades Fe 330, Fe 410 and Fe 590 have been deleted which are now covered in IS 5986 : 1992 'Hot rolled steel plates, sheets, strips and flats for flanging and forming operation'.

ii) Tensile properties have been modified.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values ( *revised* )'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# *Indian Standard*

# HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

## *( Fifth Revision )*

### 1 SCOPE

This standard covers the requirements for hot rolled carbon steel sheets including pack rolled sheets and strips intended for cold forming, drawing and general engineering purposes.

### 2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

| *IS No.* | *Title* |
|---|---|
| 228 | Method for chemical analysis of steel |
| 1599 : 1985 | Method for bend test ( *second revision* ) |
| 1608 : 1972 | Method for tensile testing of steel products ( *first revision* ) |
| 1663 : 1972 | Method for tensile testing of steel sheet and strip of thickness 0·5 mm to 3 mm ( *first revision* ) |
| 1730 : 1989 | Dimensions for steel plates, sheets, strips and flats for general engineering purposes ( *second revision* ) |
| 1852 : 1985 | Rolling and cutting tolerances for hot rolled steel products |
| 8910 : 1978 | General technical delivery requirements for steel and steel products |
| 10175 : 1982 | Method for modified erichsen cupping test for metallic sheet and strip |

### 3 SUPPLY OF MATERIAL

**3.1** General requirements relating to the supply of hot rolled carbon steel sheets and strips shall conform to IS 8910 : 1978.

**3.2** Hot rolled carbon steel sheets and strips shall be supplied either with mill edges or flattened and sheared edges. In case of strips in coil form, width above 1 500 mm may be supplied with mill edges only. Strips of width below 1 500 mm may be supplied either with mill or sheared edges.

### 4 GRADES

There shall be 4 grades of hot rolled carbon steel sheet and strip designated as follows:

a) O — Ordinary quality — intended for general fabrication purposes where sheets or strips are used in the flat or for bending, moderate forming and welding operations

b) D — Drawing quality ]
c) DD — Deep drawing quality ] intended for applications where drawing, severe forming and welding are involved
d) EDD — Extra deep drawing quality ]

### 5 MANUFACTURE

**5.1** Steel shall be manufactured by any process of steel making at the discretion of the manufacturer.

**5.2** Steel sheets and strips shall be supplied in the rimmed semi-killed or killed condition as agreed to between the purchaser and the manufacturer. However, EDD grade shall be supplied in killed condition only.

### 6 CHEMICAL COMPOSITION

#### 6.1 Ladle Analysis

Ladle analysis of the material when carried out either by the method specified in the relevant part of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method.

#### 6.2 Product Analysis

Permissible variations in case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

### 7 TENSILE TEST

#### 7.1 Number of Tensile Tests

One tensile test shall be taken from each lot of 50 t of material or a part thereof from each cast. However, in case of material supplied after heat treatment, one tensile test shall be conducted for each heat treatment batch or a lot of 50 t whichever is less.

**Table 1 Chemical Composition**

( *Clause* 6.1 )

| Grade | Constituent Percent, *Max* | | | |
|---|---|---|---|---|
| | Carbon | Manganese | Sulphur | Phosphorus |
| (1) | (2) | (3) | (4) | (5) |
| O | 0·15 | 0·60 | 0·055 | 0·055 |
| D | 0·12 | 0·50 | 0·040 | 0·040 |
| DD | 0·10 | 0.40 | 0·035 | 0·035 |
| EDD | 0·08 | 0·40 | 0·030 | 0·030 |

NOTES

1 Steels of these grades can be supplied with the addition of micro-alloying elements like boron, titanium, niobium and vanadium. The micro alloying elements shall not exceed 0·006 percent in case of boron and 0·20 percent in case of other elements.

2 The nitrogen content of the steel shall not be more than 0·007 percent. For aluminium killed or silicon-aluminium killed, the nitrogen content shall not exceed 0·012 percent. This has to be ensured by the manufacturer by occasional check analysis.

3 Grade EDD shall be supplied in fully aluminium killed condition only.

4 When the steel is aluminium killed, the total aluminium content shall not be less than 0·02 percent. When the steel is silicon killed, the silicon content shall not be less than 0·1 percent. When the steel is aluminium silicon killed, the silicon content shall not be less than 0·03 percent and total aluminium content shall not be less than 0·01 percent.

5 When copper bearing steel is required the copper content shall be between 0·20 and 0·35 percent. In case of product analysis, the copper content shall be between 0·17 and 0·38 percent.

6 For pack rolled sheets of grade 0, the phosphorus content can be relaxed up to 0·09 percent by mutual agreement between the purchaser and the supplier.

7 Restricted chemistry for EDD grade may be mutually agreed to between the purchaser and the supplier.

**Table 2 Permissible Variations for Product Analysis**

( *Clause* 6.2 )

| Constituent | Percentage Limit of Constituent | Variations Over Specified Limit, Percent, *Max* |
|---|---|---|
| (1) | (2) | (3) |
| Carbon | Up to 0·23 | 0·02 |
| Manganese | Up to 0·50 | 0·03 |
| | Above 0·50 | 0·04 |
| Sulphur | | 0·005 |
| Phosphorus | | 0·005 |

NOTE — Product analysis shall not be applicable to rimming steel.

**7.1.1** Where sheet and strip of more than one thickness are rolled from the same cast, one additional tensile test shall be made for each thickness of sheet and strip.

### 7.2 Tensile Test Pieces

Tensile test pieces shall normally be cut transverse to the direction of rolling. Longitudinal test pieces may be cut in the case of strips having width less than 150 mm.

**7.3** When tested in accordance with IS 1663 : 1972 or IS 1608 : 1972 as applicable, the tensile strength, yield stress and percentage elongation shall be as given in Table 3.

**Table 3 Tensile Properties**

( *Clause* 7.3 )

| Grade | Tensile Strength, MPa | Yield Stress, *Min* MPa | Percent Elongation at Gauge Length $5{\cdot}65\sqrt{So}$, *Min* |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| O | — | — | — |
| D | 240-400 | — | 25 |
| DD | 260-390 | — | 28 |
| EDD | 260-380 | — | 32 |

**7.3.1** Should a test piece break outside the middle half of its gauge length and the percentage elongation obtained is less than that specified, the test may be discarded at the option of the manufacturer and another test made from the sample selected representing the same cast and batch.

## 8 BEND TEST

### 8.1 Number of Bend Tests

One bend test shall be taken from each lot of 50 t of material or a part thereof from each cast. However, in the case of material supplied after heat-treatment, one bend test shall be conducted for each heat-treated batch or a lot of 50 t, whichever is less.

**8.1.1** When material is supplied in coils, one bend test shall be conducted from either end of the coil.

**8.1.2** When sheet and strip of more than one thickness are rolled from the same cast, one additional bend test shall be made for each thickness of sheet and strip.

**8.2** Bend test shall be carried out in accordance with IS 1599 : 1985.

**8.2.1** Bend test piece shall be cut so that the axis of the bend is parallel to the direction of rolling, that is, the longer axis of the test piece shall be at 90° to the direction of rolling.

8.2.2 The test piece shall be bend cold through 180°. The internal diameter of the bend for different grades of material shall be as given in Table 4. The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks after complete bending.

**Table 4 Internal Diameter of Bend**

( *Clause* 8.2.2 )

| Grade | Internal Diameter of Bend |
|---|---|
| O | 2 t |
| D | t |
| DD | Close |
| EDD | Close |

Where t is the thickness of test piece.

8.2.2.1 It is sometimes difficult to ensure that the material is accurately following the radius. In case of dispute, the test piece may be pushed into a block of lead by a former of appropriate diameter.

## 9 CUPPING TEST

9.1 Cupping test as specified in IS 10175 : 1982 may be carried out only for sheets and strips of D, DD and EDD grades having thickness from 0·5 mm up to 2 mm, if agreed to between the purchaser and the supplier.

9.2 The cupping test values shall be agreed upon between the purchaser and the supplier.

## 10 STRAIN AGEING TEST

10.1 The test is to be carried out on grades where steel is supplied with non-ageing properties/guarantee. This shall be agreed to between the purchaser and the supplier.

10.2 Selection of Sample

The sample shall be selected in such a way that the axis of bend is parallel to the direction of final rolling. In case of material too narrow to permit this, the axis of bend shall be of 90° to the direction of rolling.

10.3 Size of test piece shall be as follows:

| *Thickness* | *Size* |
|---|---|
| Below 3 mm | 75 mm long and 25 mm wide |
| 3 mm and above | 75 mm long and 40 mm wide |

For smaller sizes, the maximum obtainable width shall be taken.

The edges of the test pieces shall be rounded or smoothed longitudinally to an approximate semicircle.

10.4 The test piece shall be bent cold through 90° over a radius equal to one and a half times the thickness, about an axis at right angles to the length of the test piece. Then the piece shall be heated at 100°C for 1 h ( or at 325 to 350°C for 15 min ) and the sample cooled. The test piece shall be flattened by hammer and the piece shall not develop crack near the bend.

## 11 RETEST

Should any one of the tests pieces, first selected, fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test sample shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test sample shall be deemed as not conforming to this standard.

## 12 FREEDOM FROM DEFECTS

12.1 The finished material in cut lengths shall be free from harmful defects which will affect the end use. When the material is supplied in the form of coils, the degree or amount of surface defects are expected to be more than in cut length sheets since the inspection of coils does not afford the same opportunity to reject the portion containing defects as with cut length. However, an excessive number of defects may be a cause for rejection. The standards for acceptance in such case can be agreed to between the purchaser and the supplier.

12.2 Steel sheets supplied shall be free from coil breaks and waviness in accordance with the purchaser's requirements.

12.3 Edges may be mill edges or slit edges as agreed to between the supplier and purchaser. When mill edges are specified, the depth of the defects shall be within 5 mm from the edge of the coils on both sides.

## 13 DIMENSIONS AND TOLERANCES

13.1 Dimensions of steel sheet and strip shall conform to the dimension specified in IS 1730 : 1989.

13.2 Tolerances on length, width, thickness and mass of the steel sheet and strip shall conform to the limits specified in IS 1852 : 1985.

13.3 The edge camber that is, lateral departure of the edge of the material from a straight line forming a chord ( *see* Fig. 1 ) of hot rolled steel sheets, including descaled sheets, in cut lengths

and coil shall not exceed the tolerances given below:

| *Form* | *Camber Tolerance ( Max )* |
|---|---|
| Cut length | 0·5 percent × length |
| Coil | 25 mm in any 5 000 mm length |

NOTE — Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge.

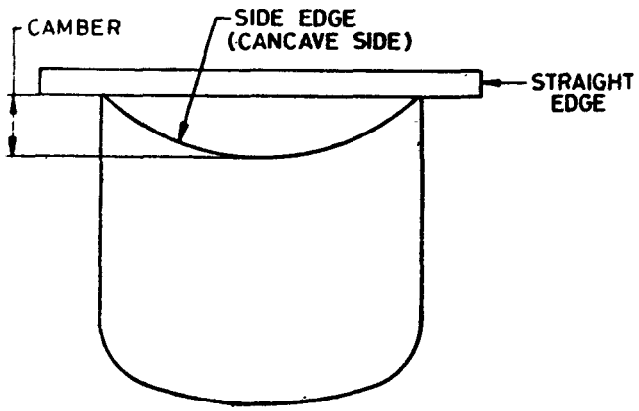


FIG. 1 EDGE CAMBER

### 13.4 Flatness Tolerances

When the sheets are required to be supplied in the flattened condition either by roller or stretcher, levelling the permissible maximum flatness ( *see* Fig. 2 ) shall be as given in Tables 5 to 7.

NOTE — Maximum deviation from a flat horizontal surface with the sheet lying under its own mass with the concave side uppermost on a flat surface, the maximum distance between the lower surface of the sheet an the flat horizontal surface is the maximum ddeviation from flatness.

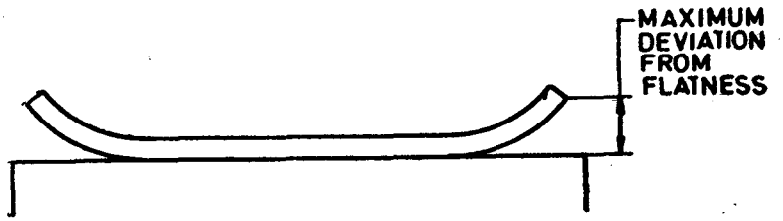


FIG. 2 FLATNESS TOLERANCE

**Table 5 Standard Flatness Tolerances for Hot Rolled Steel Sheet ( Including Descaled Sheet ) Cut Lengths**

( *Clause* 13.4 )

All dimensions in millimetres.

| Thickness | Width | Flatness Tolerance |
|---|---|---|
| Up to 2 | Up to 1 200 | 18 |
| | Above 1 200 up to 1 500 | 25 |
| | Above 1 500 | 30 |
| Above 2 | Up to 1 200 | 15 |
| | Above 1 200 up to 1 500 | 20 |
| | Above 1 500 | 25 |

**Table 6 Special Flatness Tolerances for Hot Rolled Steel Sheet ( Including Descaled Sheet ), Rolled Levelled Standard Cut Lengths**

( *Clause* 13.4)

All dimensions in millimetres.

| Thickness | Width | Length | Flatness Tolerance |
|---|---|---|---|
| Up to 2 | Up to 1 200 | Up to 2 500 | 9 |
| | Above 1 200 | Above 2 500 | 15 |
| Above 2 | Up to 1 200 | Up to 2 500 | 8 |
| | Above 1 200 | Above 2 500 | 13 |

**Table 7 Special Flatness Tolerances for Hot Rolled Sheets ( Including Descaled Sheet ), Stretcher Levelled Standard Cut Length**

( *Clause* 13.4 )

All dimensions in millimetres.

| Thickness | Width | Length | Flatness Tolerance |
|---|---|---|---|
| Up to 2 | Up to 1 200 | Up to 2 500 | 5 |
| | Above 1 200 | Above 2 500 | 8 |
| Above 2 | Up to 1 200 | Up to 2 500 | 3 |
| | Above 1 200 | Above 2 500 | 6 |

NOTE — These tolerances are applicable for sheets up to 5 metres in length. For sheets supplied in greater lengths, the tolerances shall be as agreed to between the purchaser and the manufacturer.

### 13.5 Out-of-Square Tolerances

The out-of-square tolerance for sheets of all gauges and all sizes shall be 1·0 percent of width ( *see* Fig. 3 ).

NOTE — Out-of-square is the greatest deviation of an edge from a straight line drawn at a right angle to the other edge of the sheet, touching one corner and extending the opposite edge.

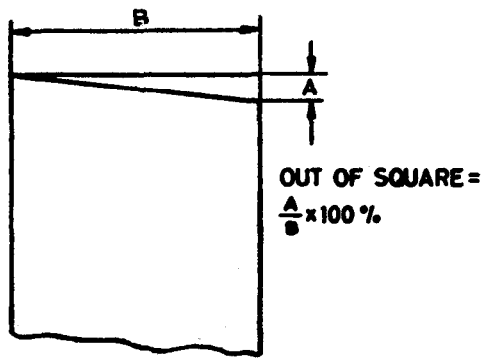


FIG. 3 MEASUREMENT OF OUT-OF-SQUARENESS

## 14 CALCULATION OF WEIGHT

The mass of the material shall be calculated on the basis that steel weighs 7·85 g/cm³.

## 15 DELIVERY

**15.1** The material may be supplied in any one (or, in combination) of the following conditions subject to mutual agreement between the supplier and the purchaser:

a) Hot rolled,

b) Annealed,

c) Normalized, and

d) Descaled.

**15.2** Subject to prior agreement between the manufacturer and the purchaser, a suitable protective treatment may be given to the material.

## 16 MARKING

**16.1** Sheets shall be supplied in bundles, and strips either in bundles or coils. The mass of the bundle or coil shall not exceed 12·5 tonnes. Each bundle or coil shall carry a metal tag bearing the cast number and the manufacturer's name or trade-mark. Alternatively, the top sheet or strips in each bundle shall be legibly marked with the cast number, name of the manufacturer or trade-mark.

### 16.2 Standard Marking

The material may also be marked with Standard Mark.

**16.2.1** The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act 1986, and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

**Bureau of Indian Standards**

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.



**Review of Indian Standards**

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc : No. MTD 4 ( 3933 )

**Amendments Issued Since Publication**

| Amend No. | Date of Issue | Text Affected |
|---|---|---|
| | | |
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# AMENDMENT NO. 1 JUNE 1996
# TO
# IS 1079 : 1994 HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

*( Fifth Revision )*

( *Page* 1, *clause* **2** ):

a) Substitute '1608 : 1995 Mechanical testing of metals — Tensile testing ( *second revision* )' *for* '1608 : 1972 Method for tensile testing of steel products ( *first revision* )'.

b) Delete '1663 : 1972 Method for tensile testing of steel sheet and strip of thickness 0.5 mm to 3 mm ( *first revision* )'.

c) Substitute '10175 ( Part 1 ) : 1993 Mechanical testing of metals — Modified erichsen cupping test — Sheet and strip: Part 1 Thickness up to 2 mm ( *first revision* )' *for* '10175 : 1982 Method for modified erichsen cupping test for metallic sheet and strip'.

( *Page* 2, *clause* **7.3**, *lines* 1 *and* 2 ) — Substitute 'IS 1608 : 1995' *for* 'IS 1663 : 1972 or IS 1608 : 1972 as applicable'.

( *Page* 3, *clause* **9.1**, *line* 1 ) — Substitute 'IS 10175 ( Part 1 ) : 1993' *for* 'IS 10175 : 1982'.

( *Page* 5, *clause* **16.1**, *line* 3 ) — Delete the words 'or coil'.

( MTD 4 )

Reprography Unit, BIS, New Delhi, India

# AMENDMENT NO. 2 OCTOBER 1997
# TO
# IS 1079 : 1994 HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

*( Fifth Revision )*

( *Page* 3, *clause* 13.1, *line* 1 ) — Insert at the beginning 'Unless agreed otherwise,'.

( MTD 4 )

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# AMENDMENT NO. 3 APRIL 2002
# TO
# IS 1079 : 1994 HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

*( Fifth Revision )*

( *Page* 1, *clause* **7.1** ) — Substitute the following for the existing:

**'7.1 Number of Tensile Tests**

Number of samples to be tested from a cast/heat shall be as follows:

a) for cast/heat size up to 100 tonnes — 2 samples,

b) for cast size between 100-200 tonnes — 3 samples, and

c) for cast size over 200 tonnes — 4 samples.

However, in case of material supplied after heat treatment, one tensile test shall be conducted for each heat treatment batch or a lot of 50 tonnes, whichever is less.'

( MTD 4 )

# AMENDMENT NO. 4 NOVEMBER 2002
# TO
# IS 1079 : 1994 HOT ROLLED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

***( Fifth Revision )***

( *Foreword* ) — Insert the following before last para:

'For all the tests specified in this standard (chemical/physical/others), the method as specified in relevant ISO standard may also be followed as an alternate method.'

( MTD 4 )

Reprography Unit, BIS, New Delhi, India